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Abstract. Today, transport-related charges hold an important place in practically all national tax systems. They constantly updated to stay in line with the goals of "green policy". Such charges are becoming a mechanism of price regulation that forces car users to change their consumption patterns. The purpose of this article is to study the impacts that the existing structure of transport-related charges has on the environment and propose measures for making them more environmentally-focused. Transport-related charges were classified either as fixed or variable depending on whether the size of the charge is in proportion to the intensity of car use. The environmental impact of transport-related charges was identified through analysis of the functions that each levy performs. The analysis conducted in the study proved that Russia practically lacks regulation targeting the behavior of producers and consumers of motor vehicles and fuel. The existing system of transport related charges is revenue-focused, i.e., it satisfactorily performs only its fiscal function. At the same time, the regulatory potential function of transport-related charges in Russia remains practically untapped. The system of transport-related charges in Russia is dominated by fixed charges, the amount of which does not depend on the intensity of car use. Variable transport-related charges in Russia are fewer in number, so they cannot serve as a driver for behavior change towards sustained environmentally friendly habits in car owners. The article outlines a set of proposals for making some fixed transport-related charges in Russia more environmentally-focused and for increasing the environmental benefits of variable transport-related charges.

1. Introduction

Economic development has made transport in all its forms an indispensable element of today's economy as it serves both the needs of industry and households. The share of the transportation sector in the GDP of modern economies ranges from 2 to 5%. At the same time, transport represents 20 to 25% of total energy use. Transport has turned into an industry that has a significant impact on people's lives. There is a link between per-capita GDP in a country and the share of transport in energy consumption. The more developed the country, the bigger share transport has in energy consumption [1]. As a result, developed countries that hold the leadership in the field of research and state regulation of transport-related environmental problems become ever more responsible for the intensifying negative effects of transport.

Today, transport-related charges hold an important place in practically all national tax systems. They constantly updated to stay in line with the goals of "green policy". Such charges are becoming a

mechanism of price regulation that forces car users to change their consumption patterns.

The goal of the greening of transport-related charges is particularly relevant to Russia. According to the World Health Organization, air pollution caused over 70,000 deaths in Russia in 2008. There is a correlation between mortality and morbidity rates and the growing car fleet in Russia. Until 1990, public transport was the main means of transportation for people in Russia as the number of cars per 1,000 people was only 50. That was when private car ownership started to grow, and continues to grow to this day. Nationally, the car ownership rate has now reached 320 vehicles per 1,000 people and even 500 vehicles per 1,000 in some regions. Meanwhile, public transport has ceased to develop.

Additionally, growing car ownership has not led to a cardinal improvement in the environmental performance of the car fleet: nearly three fourths of motor vehicles in Russia do not comply with the latest emission standards. One of the reasons why the negative structure of the car fleet persists is the emphasis on the fiscal function of transport-related charges, while their regulatory potential remains largely untapped. This highlights the task of making transport-related charges in Russia more environmentally-focused.

The purpose of this article is to study the impacts that the existing structure of transport-related charges has on the environment and propose measures for making them more environmentally-focused.

2. Theoretical analysis

Active development of the car fleet at the beginning of the 20th century and consequences resulting from its use led to the formation of new methodological approaches to determining the size of transport taxes presented by the British school of road pricing. One of its representatives, A Pigou [2], suggested He suggested that transport taxes should be viewed as a way of internalizing negative externalities that occur in the process of automobile use. In this case, the size of transport taxes should reflect the tax price of the negative external effects so that the car owner pays for them with his money. Most of those effects are paid for by local governments that have to increase spending on road maintenance services, health care, emergency services and environmental services, etc. It is the implementation of the "user-pays principle" [3]. The studies conducted by this school resulted in equations which make it possible to determine the size of externalities on one route (road).

We believe that all payments that form the system of transport taxation should fulfill the following functions:

- *fiscal function*, i.e. to have a significant distributive and allocative potential;
- *regulatory function*, i.e. to have a significant regulatory and behavioral potential.

Through the simultaneous implementation of fiscal and regulatory functions, the transport taxes embody the idea of double dividend, where environmentally oriented behavior of car owners will be accompanied by the formation of stable revenue sources for road construction and environmental protection. The need to address the regulatory function of the transport fees and the use of fiscal instruments for the promotion of environmentally-oriented behavior of producers and owners of vehicles and related products is recognized by most analysts and researchers [4-7].

Dividing transport-related charges on fixed and variable ones is important for the purposes of analysis of the technical organization of the system of transport taxation and the purposes of functional analysis.

Fixed taxes. The tax rates are not pegged to the intensity of car use, which means they do not directly involve the car owner in compensating for negative externalities. Yet their size is a determining factor in the affordability of a car with certain environmental characteristics; it influences the level of car ownership in society and forming a specific car fleet structure [8-10].

Variable taxes the amount of which is determined by the intensity of car use. In this case, the size of transport taxes should reflect the tax price of negative externalities, while each car owner should pay an amount that is equivalent to the total of negative externalities caused by the operation of his/her car. A sophisticated system of variable taxes makes it possible to effectively administer the process of recovering marginal external costs while precisely factoring in all kinds of impact [6,9].

3. Methodology

The following research methods were used in the course of the study: comparative and critical analysis, grouping, tables and graphs.

When investigating the structure of transport-related charges, the method of comparative analysis was used that provided for a conclusion about the green value of fixed and variable transport-related charges in Russia. The subject of the analysis were the charges that were in force as of January 2019.

Transport-related charges were classified either as fixed or variable depending on whether the size of the charge is in proportion to the intensity of car use. If the size of a levy varied in line with the intensity of car use, it was categorized as a variable charge. If the amount of a levy was not in relation to car use intensity, it was categorized as a fixed charge.

The environmental impact of transport-related charges was identified through analysis of the functions that each levy performs. If a levy only has a fiscal function, the conclusion was made that it does not have an impact on the environment. If the levy being analyzed has a regulatory function along with a fiscal one, the conclusion was that has an environmental impact. Finally, the authors used expert judgement to assign the weight to the environmental impacts by differentiating among those with strong, medium and weak manifestation.

4. Classification of fixed and variable transport-related charges in Russia

We have systematized all transport-related charges that are in force in Russia and presented them in table 1.

Table 1. Transport-related charges in Russia and dependence of the amount charged on car intensity use.

	Levy	Dependence on car use	Type of charge
1	Value-added tax	no	fixed
2	Car sales tax	no	fixed
3	Registration fee	no	fixed
4	Recycling fee	no	fixed
5	Vehicle tax	no	fixed
6	Parking fee	no	fixed
7	Compulsory Third Party Insurance	no	fixed
8	Fuel excise taxes	yes	variable
9	Motorway tolls	yes	variable
10	Truck toll	yes	variable

The system of transport-related charges in Russia is dominated by fixed charges. Seven types of transport-related charges are of fixed kind, that is, the amount to be paid does not depend on the intensity of car use. There are only three transport-related levies that are of variable nature, that is, their size depends on the intensify of car use.

4.1. Fixed transport-related charges

Value-added tax is paid at all stages of car production at a rate of 20%. Value-added tax is also applicable to the sale of other goods (fuel, oils). As a result, VAT is paid on the sale of the vehicle itself as well as all auxiliary goods and services that are required for its operation and maintenance.

Excise duties are paid by the manufacturer (or importer in case of imported vehicles) on the sale of automobiles with an engine power of over 90 horsepower and on motorcycles with an engine power of over 150 horsepower. Freight vehicles and buses are exempted from excise taxes. Excise taxes are progressive. For cars with an engine power between 90 and 150 engine power it is USD 0.7 per horsepower. The rate grows to USD 19.3 per horsepower for cars with an engine power exceeding 500 horsepower.

A recycling fee is payable on all wheeled vehicles in Russia. The fee is due before the car owner

registers the vehicle with the authorities. It guarantees that

It ensures that car owners will not be charged extra when vehicles have to be disposed of. The fee is payable by car manufacturers or importers. The rates of the fee depend on the type of vehicle: USD 290 for automobiles and USD 2,170 for freight vehicles. There are fee-increasing factors that depend on the engine power and age of the vehicle (tonnage in case of freight vehicles). For example, a factor of 6.3 is applied to new 2,000 to 3,000cc automobiles. The recycling fee for trucks with gross tonnage of 3.5 to 5 t is applied with a growth factor of 2.09. The recycling fee therefore amounts to USD 1,800 for an automobile and USD 4,480 for a truck. The vehicle's emissions standard is not taken into account.

A registration fee is payable by the car owner when she or he registers the vehicle with the authorities. It is set at USD 54 and does not depend on the vehicle's emissions standard or its engine power.

Vehicle tax is essentially a tax on car ownership, that is, it is a property tax that is paid annually by car owners. The amount of the tax based on the horsepower of the vehicle and varies depending on the type of vehicle: automobiles, freight vehicles, buses, motorcycles etc. The rates are strongly progressive. The tax progression is particularly pronounced in the case of automobiles. For example, the difference between the tax rates applicable to cars with an engine power of 100 hp and 250-hp ones is six-fold, while the difference between the tax rates levied on trucks with the same engine characteristics is threefold. Such an approach does not take into consideration the age and the polluting emissions level of the vehicle. Nor does it take into account the impact of trucks on the road surface.

Parking fee should be examined from two perspectives: as a resident's parking charges, that is a regular fee paid for parking a car near the owner's place of residence, and as a non-resident's parking fee, that is a charge payable each time a car is parked in downtown areas or near tourist attractions. Parking fees strongly differ depending on the town size. In a medium-sized municipality, the parking fee averages USD 35 a month. Non-resident parking usually costs USD 0.5 per hour in a mid-sized town.

Every car owner is obliged to take out an annual third-party car insurance policy. The insurance covers the insurer against legal liability in case of a road accident. The cost of repairing any damages to the third-party vehicle or injuries will be paid by the insurance company. The premium rate depends on the type of vehicle and the motorist's driving record in the previous year. A yearly renewed third-party car insurance policy costs USD 150 on average.

4.2. Variable transport-related charges

Fuel excise taxes are payable by the manufacturer and are incorporated into the price of fuels. The tax rates vary depending the environmental class of fuel. The rates are higher for fuels that do not meet Class 5 standards and are lower for Class 5 fuel. The difference between the rates is not great, though. For example, the tax rate on Class 5 petrol is only 1.08 times lower than on petrol that does not comply with Class 5 requirements (USD 187 per ton).

Toll charges are paid on entry to toll roads, the number of which is growing in Russia. Toll rates depend on the type of vehicle, time of day and the payment method. If paid in cash at the toll gate, the toll might be 50% higher than the pay collected by means of a transponder. On average, the toll rate is USD0.15 per km.

The truck toll is levied on heavy freight vehicles with tonnage in excess of 12 t using federal motorways. The distance-based toll is payable in advance and is supposed to recuperate the damage caused by heavy vehicles to the road surface. The Russian truck toll collection system is branded Platon. Federal roads constitute only a portion of the national road network in Russia. Federal motorways are typically of better quality and connect the central cities of Russia's regions. The truck toll rate is USD 0.03 per km.

5. Environmental effects of fixed and variable transport-related charges in Russia

Analysis of the functions performed by various transport-related charges enabled us to conclude that

all of them mainly serve fiscal purposes. Fixed transport-related charges fulfill fiscal purposes only. The regulatory function only occurs in variable transport-related charges (table 2).

Table 2. Fiscal and regulatory functions in transport-related charges in Russia.

	Charges	Fiscal function	Regulatory function
1	Value-added tax	yes	no
2	Car sales tax	yes	no
3	Registration fee	yes	no
4	Recycling fee	yes	no
5	Vehicle tax	yes	no
6	Parking fee	yes	no
7	Compulsory Third Party Insurance	yes	no
8	Fuel excise taxes	yes	yes
9	Motorway tolls	yes	yes
10	Truck toll	yes	yes

Note: yes - the levy fulfills the function, no - the levy does not fulfill the function.

The regulatory function of fuel excise taxes is adjusted in the following way. Excise taxes on fuel are designed to establish the correlation between the amount of mileage of the car and the financial participation of the owner in the financing of roads in the region. Advantage of the excises is that they take into account the complex environmental properties of the consumed fuel and thus correlate with the use of the road network by car owners.

The environmental effect of fuel excise taxes manifests itself through changes in production and consumption of fuel towards better emission characteristics. We assess the environmental effect as medium because although there is some difference in the tax rates applied to fuels complying with different environmental class standards, it is not very significant. Moreover, the tax rate on diesel fuel is unreasonably low compared to the tax rate on petrol (1.5-times lower), which is a mismatch between the negative environmental impacts of burning diesel and petrol.

The environmental effect of toll charges are very weak. The differentiation of toll rates is based only on vehicle types (passenger automobiles and medium-duty freight vehicles).

The environmental effect of the truck toll, is very weak, too. The amount to be paid depends on the length of the journey but has no relation to the environmental class of the vehicle. An assessment of the environmental effects of variable transport-related charges are presented in table 3.

Table 3. Environmental effects of variable transport-related charges in Russia.

	Levy	Magnitude of environmental effects
1	Fuel excise taxes	++
2	Motorway tolls	+
3	Truck toll	+

Note: + weak manifestation of environmental effects, ++ medium manifestation и +++ weak manifestation.

Consequently, fixed transport-related charges were not found to exhibit any environmental effects, while variable transport-related charges do exhibit such effects, but the magnitude of their manifestation is hardly satisfactory.

6. Prospects of the greening of transport-related charges in Russia

In a mid-term perspective, it is advisable to add green value to some fixed transport-related charges and increase the environmental benefits of variable transport-related charges. For that sake, the following measures are proposed.

Excise taxes on the sale of a vehicle should be differentiated according to environmental classes. The current rate should be the basis for taxation for vehicles of the highest environmental class. For

lower ecological class cars, an operating excise tax rates should be increased 5 times. Furthermore, zero rate for low-power cars (up 90 horsepower) should be removed, and the current rate of excise should be used on them. Furthermore, zero rate for low-power cars (up 90 horsepower) should be removed, and the current rate of excise should be used on them. Excise tax on the sale should be extended also to trucks.

Registration fees can be differentiated with regard to cars' compliance with emission standards. The rates could be higher for Class 3 and 4 vehicles. A growth factor could be applied to the existing registration fees. This measure would be particularly relevant to individuals buying aging cars from other people.

Transport tax should also be differentiated depending on the environmental class. Class 5 cars should have a reduction coefficient of 0.5. Current rates should remain unchanged for class 4 cars (coefficient 1.0). For lower ecological class vehicles it is necessary to establish a heightening coefficient. The weight of the coefficient can depend on the environmental impact of the car.

Utilization fee should also be differentiated according to environmental classes of cars. The idea is to transform the utilization fee into the excise tax on disposal of the car, i.e., to make the utilization fee a tax. It is proposed to make the excise tax on disposal. The differentiation of its size should be based on the same principles as for the excise tax on the sale of a vehicle [11].

There should be more differentiation in the rates of fuel excise taxes in relation to petrol emission standards. Additionally, it is necessary to ensure a correlation between the tax rates on petrol and diesel fuel and the environmental impacts of burning these types of fuel in cars. It is also appropriate to consider introducing an excise tax on natural gas used as a vehicle fuel.

The truck toll rates should also be differentiated based on vehicles' environmental class. It would logical to have a reduction factor of 0.8 on the tall rate applied to Euro 5 trucks.

The consequences of a change in transport charges for urban agglomerations can be assessed using the results of the SWOT-analysis presented in table 4.

Table 4. SWOT-analysis of transport payment system changes in urban agglomerations in Russia.

Strengths:	*Weaknesses:*
A growth of income from transport taxes and payments to the state budget	A growth of prices for cars and transport services
Forming of the environmentally rational structure of the car fleet	Minor experience in the use of modern information systems for tolls
Road transport emission reduction	
Opportunities:	*Treats:*
Active development of public transport	Reduced population mobility
Additional funding for environmental improvement measures	Possible social protests
Improved condition and reduced wear of roads due to reduced traffic	

The identified weaknesses and threats make possible, together with changes in the system of transport charges, to formulate additional strategic actions which will be neutralize the threats. First, it is necessary to develop plans for activating public transport in urban agglomerations. Secondly, serious information work is needed that can form the right attitude of the population to changes in the transport related charges.

7. Conclusion

It appears to be of critical importance for any country to regulate the behavior of car manufacturers and motorists to ensure that they form sustained environmentally-friendly behavior patterns. Fiscal regulatory mechanisms, including various types of transport-related charges, have proved most effective in countries with high car ownership rates. By combining fiscal and regulatory options in various types of traditionally used transport-related charges, European countries with high car

ownership rates have had considerable success in fostering environmentally responsible behavior in producers and consumers of cars and fuel. As a result of such regulatory policies, car owners are opting to buy vehicles complying with higher emission standards and to use cars less.

The analysis conducted in the study proved that Russia practically lacks regulation targeting the behavior of producers and consumers of motor vehicles and fuel. The existing system of transport related charges is revenue-focused, i.e., it satisfactorily performs only its fiscal function. At the same time, the regulatory potential function of transport-related charges in Russia remains practically untapped.

The system of transport-related charges in Russia is dominated by fixed charges, the amount of which does not depend on the intensity of car use. Variable transport-related charges in Russia are fewer in number, so they cannot serve as a driver for behavior change towards sustained environmentally friendly habits in car owners.

The article outlines a set of proposals for making some fixed transport-related charges in Russia more environmentally-focused and for increasing the environmental benefits of variable transport-related charges. That could be achieved by having fixed transport-related charges that are differentiated based on vehicles' environmental class. That would make it uneconomical for motorists to own a vehicle that only meets outdated emissions standards.

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